

ORIGINAL PAPERS

Prevalence of Dry Eye Disease in Undergraduate Medical Students and its Association with Online Overexposure Due to Coronavirus Disease (COVID-19)

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Abstract

Objectives: To understand the prevalence of dry eye disease (DED) in undergraduate medical students and assess its association with online overexposure due to COVID-19. **Materials and methods:** The study was carried out with 200 medical undergraduate students aged 18-25 years at North Indian Medical College during the third and fourth weeks of September, 2021 & enquired regarding the online exposure pattern, type of device used and presence of eight dry eye symptoms (foreign body sensation, vision difficulties, discharge, itching, ocular pain, redness, photophobia, watering) followed by Schirmer's strips examination. Cut off for dry eye disease was <10 mm. Data was analyzed using SPSS 21.0 package & Chi-square test for comparisons. **Results:** Mean age was 21.00±1.93 years. Majority were females (54.5%). Prevalence of dry eye symptoms was 85.5%. Vision difficulties (54.0%), itching (56.0%), watering (51.5%) were the most common symptoms. Majority (64.0%) had >3 symptoms. Use of mobile device, >4 hours of online exposure for other than study purposes and >1.5 increase in online exposure after COVID-19 were associated with presence of >3 dry eye symptoms. On Schirmer's test, prevalence of dry eye disease was 12.0%. **Conclusion:** Longer duration of online exposure and increase in online activities as a result of COVID-19 was associated with an increased risk of dry eye disease and its prevalence in undergraduate medical students.

Keywords: COVID-19, Dry eye disease symptoms, Online exposure, Schirmer's test Undergraduate medical students.

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INTRODUCTION

Digital eye strain or computer vision syndrome is a widely acknowledge disorder associated with overexposure to digital device use with its reported prevalence being as high as 50.0% [1]. Computer vision syndrome is a constellation of ocular and visual symptoms broadly falling into two major categories, *viz.*, accommodative or binocular vision stress and dry eye [1]. While the relationship between digital device overexposure and computer vision syndrome has been evaluated extensively in different populations [2,3,4], however, there are limited studies evaluating its impact in terms of symptoms and prevalence of dry eye disease [5]. During the corona virus (COVID-19) pandemic, there has been a tremendous increase in the online activities. In view of protracted lock-downs, movement restrictions and COVID-19 protocols, education, business, entertainment, shopping, recreation, government transactions and social interactions have transformed from a physical to virtual world. Medical education is one of the most adversely affected academic field during the COVID-19 pandemic. Owning to significance of continued learning, medical students have to not only attend to the online classes but have to use extensive online resources to update them about newer advancements in medical field as well as to carry out group discussions and other academic activities. Moreover, in view of the absence of any other source of recreation and entertainment they have to look upon online platforms for this purpose as well as to carry out social interactions.

There is evidence showing that growing online exposure during COVID-19 has contributed to increased burden of computer vision syndrome among students [6,7,8]. Previous studies have shown a relationship between digital device use and dry eye disease [9], however, there are no studies reporting whether the increased online exposure in the COVID-19 era has contributed to the burden of dry eye disease symptoms. Understanding the relevance of this issue, the present study was carried out to assess the prevalence of dry eye disease (DED) and its symptoms in Medical Undergraduates in context with online overexposure during COVID-19.

MATERIAL AND METHOD

After approval from the ethics committee a study study was carried out at a North Indian medical college during the third and fourth weeks of September, 2021

among undergraduate medical students after obtaining consent from them. The study was in accordance of declaration of Helsinki.

Inclusion criteria: MBBS I to IX semester students aged 18 to 25 years willing to participate in the study were enrolled in the study. Those reporting a history of any eye disease were excluded from the study.

Data for the study was collected using a structured proforma comprising of three sections. Demographic information and items related with inclusion and exclusion criteria comprised the first section. The second section contained a questionnaire evaluating the average daily duration of online studies, type of device used for the purpose, average online exposure for other than studies purposes and a self-assessment of change in online exposure pattern during COVID-19.

The third section checked the presence of a total of eight dry eye symptoms, *viz.* foreign body sensation, burning, discharge, itching, heaviness, redness, photophobia, watering and eye pain/heaviness experienced by the students during last two-weeks.

After the assessment was over, assessment of dry eye disease was done in all the students using Schirmer's test. The cut-off for diagnosis of dry eye disease was kept at <10 mm. Both the eyes were examined by a trained ophthalmologist. Disability achieve ≥ 10 mm in either of two eyes was marked as dry eye disease. All the students were counseled regarding rational use of computer/digital device screen, including reduction of exposure period specially for non-study purposes, resting the eyes for 15 minutes after every two hours of continuous exposure, refocusing at every 20 minutes and blinking. Those diagnosed of dry eye disease were advised to use tear drops/gels/moisteners thrice a day as well as 15 minutes before and immediately after a prolonged (≥ 2 hrs) online exposure.

Data Analysis: Statistical Package for Social Sciences, version 21 was used to analyze the data. Graphical representation was made using MS-Excel 2012. Chi-square test was used to compare the data "p-value" less than 0.05 was considered significant.

RESULTS

Mean age of respondents was 21.0 ± 1.93 years. Majority were females (54.5%) and were students of semesters I/II or III/IV. For the purpose of online studies, maximum (44.5%) students had 4-6 hours of online exposure followed by those having >6 hours of online expo-

sure (34.5%) and <4 hours of online exposure (21.0%) respectively. Maximum (47.0%) students used mobile phone for their online activities followed by those using laptop/desktop (30.0%). There were 36 (23.0%) students reporting use of both mobile as well as laptop/desktop for online activity. Apart from study purposes, majority of students (52.0%) reported 2-4 hours of daily online activity followed by those reporting >4 hours of

online activity (33.5%) and <2 hours of online activity (14.5%) respectively. Only 27 (13.5%) students found a decline or no change in their online activities during COVID-19. Maximum (37.0%) reported upto 1.5 times increase followed by those reporting 1.5-2 times increase (30.5%) and >2 times increase (19.0%) respectively (Table 1).

Table 1: General Profile and Characteristics of Study Population (n=200)

SN	Characteristic	No.	Percentage (%)
1.	Mean age $\pm$ S.D.* (Range) in years	21.00 $\pm$ 1.93 (18-25)	
2.	Sex		
	Male	91	45.5
	Female	109	54.5
3.	Semester		
	I/II	52	26.0
	III/IV	56	28.0
	V/VI	49	24.5
	VII and above	43	21.5
4.	Average daily time for online study		
	<4 hrs	42	21.0
	4-6 hrs	89	44.5
	>6 hrs	69	34.5
5.	Type of device for online activities		
	Mobile phone	94	47.0
	Laptop/Desktop	60	30.0
	Both	46	23.0
6.	Average duration of online exposure for other than study activities		
	<2 hrs	29	14.5
	2-4 hrs	104	52.0
	>4 hrs	67	33.5
7.	Self-rated change in online exposure following COVID-19		
	Decline or no change	27	13.5
	1-1.5 times increase	74	37.0
	1.5-2 times increase	61	30.5
	>2 times increase	38	19.0

*S.D.: Standard Deviation

Prevalence of dry eye symptoms was 85.5%. Vision difficulties (54.0%), itching (56.0%) and watering (51.5%) were the most common symptoms affecting majority of respondents. Redness (49.0%), eye pain (48.0%), photophobia (46.0%) and foreign body sensation (42.0%) were the other common complaints. A

total of 61 (30.5%) students reported of discharge from eye. Majority (64.0%) had >3 symptoms. Mean number of symptoms was 3.80 $\pm$ 1.96. On Schirmer's test, a total of 24 (12.0%) students tested positive for dry eye disease (Table 2).

Table 2. Prevalence of Symptoms of Dry Eye in study population

SN	Complaint	No. of students	Percentage (%)
1.	Foreign body sensation	84	42.0
2.	Vision difficulties	116	54.0
3.	Itching	112	56.0
4.	Discharge	61	30.5
5.	Redness	98	49.0
6.	Photophobia	92	46.0
7.	Watering	103	51.5
8.	Eye Pain	96	48.0
9.	Total no. of students with any symptom	171	85.5
10.	No. of students with >3 symptoms	128	64.0
11.	Mean number of symptoms± S.D. (Range)	3.80±1.96 (0-7)	
12.	Prevalence of Dry eye disease	24/200 (12.0%)	

*S.D. : Standard Deviation

On evaluating association of different demographic and online exposure pattern with prevalence of dry eye symptoms, use of mobile device, >4 hours of online exposure for other than study purposes and >1.5 increase in online exposure after COVID-19 were significantly associated with presence of >3 dry eye symptoms (Table 3).

Table 3. Association Dry Eye Symptom Status with different demographic factors and online exposure pattern

SN	Characteristic	≤3 Symptoms (n=72)		>3 Symptoms (n=128)		Statistical significance	
		No.	%	No.	%	c	'p-value'
1.	Mean Age± S.D. (Years)	20.72±1.85		21.15±1.96		t=1.504; p-value =0.134	
2.	Sex					0.439	0.508
	Male	35	48.6	56	43.8		
	Female	37	51.4	72	56.3		
3.	Semester					2.148	0.542
	I/II	23	31.9	29	22.7		
	III/IV	18	25.0	39	29.7		
	V/VI	17	23.6	32	25.0		
	VII or above	14	19.4	29	22.7		
4.	Duration of online studies					4.926	0.085
	<4 hrs	19	26.4	23	18.0		
	4-6 hrs	35	48.6	54	42.2		
	>6 hrs	18	25.0	51	39.8		
5.	Device type					18.807	<0.001
	Mobile	20	27.8	74	57.7		
	Laptop/Desktop	33	45.8	27	21.1		
	Both	19	26.4	27	21.1		
6.	Average duration of online exposure for other than study purposes					10.813	0.004
	<2 hrs	17	23.6	12	29.1		
	2-4 hrs	39	54.2	65	50.8		
	>4 hrs	16	22.2	51	39.8		
7.	Self-rated change in online exposure following COVID-19					44.379	<0.001
	Decline or no change	19	26.4	8	6.3		
	Upto 1.5 times increase	39	54.2	35	27.3		
	1.5-2 times increase	11	15.3	50	39.1		
	>2 times increase	3	4.2	35	27.3		

For Schirmer's test positivity, online studies for >6 hours, use of mobile phone for online activities, >2 times increase in online exposure following COVID-19 and presence of >3 dry eye symptoms showed a significant association (Table 4).

Table 4. Association of Dry Eye Disease status with different demographic factors and online exposure pattern (n=200)

SN	Characteristic	DED (n=24)		No DED (n=174)		Statistical significance	
		No.	%	No.	%	c	'p-value'
1.	Mean age± S.D.	21.38±1.81		20.94±1.94		t=1.029; p-value =0.305	
2.	Sex						
	Male	12	50.0	79	44.9	0.223	0.637
	Female	12	50.0	97	55.1		
3.	Semester						
	I/II	9	37.5	43	24.4	7.143	0.067
	III/IV	10	41.7	46	26.1		
	V/VI	2	8.3	47	26.7		
	VII or above	3	12.5	49	22.7		
4.	Duration of online studies						
	<4 hrs	2	8.3	40	22.7	9.722	0.008
	4-6 hrs	7	29.2	82	46.6		
	>6 hrs	15	62.5	54	30.7		
5.	Device type						
	Mobile	17	70.8	77	43.8	7.729	0.021
	Laptop/Desktop	6	25.0	54	30.7		
	Both	1	4.2	45	25.6		
6.	Average duration of online exposure for other than study purposes						
	<2 hrs	2	8.3	27	15.3	2.432	0.296
	2-4 hrs	16	66.7	88	50.0		
	>4 hrs	6	25.0	61	34.7		
7.	Self-rated change in online exposure following COVID-19						
	Decline or no change	1	4.2	28	14.8	20.05	<0.001
	Upto 1.5 times increase	3	12.5	71	40.3		
	1.5-2 times increase	8	33.3	53	30.1		
	>2 times increase	12	50.0	26	14.8		
8.	>3 symptoms	20	83.3	108	61.4	4.424	0.035

*S.D. : Standard Deviation

DISCUSSION

The present study showed a high prevalence of dry eye symptoms (85.5%), co-existence of 3 or more symptoms (64.0%) and Schirmer's test positivity (12.0%) in the undergraduate medical students. Dry eye disease is a significant problem with prevalence ranging from 7.4% to 33.7% [10,11]. However, approximately two-thirds of patients affected by DED are females and el-

derly [11,12]. Thus such high prevalence of dry eye disease and its symptoms in an otherwise healthy young population is an issue of concern. However, such high prevalence of dry eye disease and its symptoms is not uncommon in specific population such as office workers [13], college-students [14] and visual-terminal workers [15]. In the present study, although the prevalence of Schirmer's test positivity was relatively less (12.0%) as compared to that reported by Mufti *et al.* [5] and Faruqi

et al. [9] who reported this prevalence to be as high as 55.6% and 20.9% respectively in medical students, yet a high proportion of students had presence of >3 symptoms, thus placing them at a high risk of developing dry eye disease in near future.

The findings of the present study showed that there was a relationship between time spent on online activities and digital device screen size with DED symptoms and their prevalence. In the present study we also found that an increase in online exposure time due to COVID-19 has also resulted in an increase in DED symptoms and its prevalence. Excessive digital exposure is related with a high prevalence of dry eye disease symptoms. In a previous study, almost half the computer users were found to have more than four dry eye disease symptoms [16]. The study highlighted that online activities on smaller screen media like mobile phones could lead to an additional stress leading to symptomatic manifestation of dry eye disease.

As far as association of COVID-19 with increased prevalence of dry eye disease has been explained to have a multifactorial basis. No doubt overexposure to digital devices and online activities are one of the most common reasons behind it but other factors also contribute equally. Giannaccare *et al* [17] in their study described other possible factors as use of face mask. They described that the displacement of the mask or its incorrect fitting could disperse air around the eyes, and the air leaking could cause a rapid evaporation of tears resulting in dry eye disease or its symptoms. In the present study we did not enquire regarding the mask wearing practices in

the studied population and hence are not in a position to comment over this aspect as a possible contributory factor. Nevertheless, the present study showed that a direct association of high prevalence of dry eye disease and its symptoms in a population experiencing heavy online activity as a result of COVID-19.

It is often being heard that the recent years will bring about an upsurge in online activities, especially for academic purposes or for other non-academic activities, the experience learnt from this study shows that there is a need to exercise extreme caution and reemphasizes the importance of physical world over virtual world.

CONCLUSION

The present study showed a high prevalence of dry eye disease and its symptoms in medical undergraduate having a heavy online exposure due to COVID-19 and further studies should be done regarding online overexposure among students. It is important that transition to virtual learning should be made after going through the physical and psychological impacts of such shift.

Compliance with ethics requirements: The authors declare no conflict of interest regarding this article. The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law. Informed consent was obtained from all the patients included in the study.

References

1. Sheppard AL, Wolffsohn JS. Digital eye strain: prevalence, measurement and amelioration. *BMJ Open Ophthalmol* 2018;3(1):e000146.
2. Altalhi A, Khayyat W, Khojah O, Alsalmi M, Almarzouki H. Computer Vision Syndrome Among Health Sciences Students in Saudi Arabia: Prevalence and Risk Factors. *Cureus* 2020;12(2):e7060.
3. Al Rashidi SH, Alhumaidan H. Computer vision syndrome prevalence, knowledge and associated factors among Saudi Arabia University Students: Is it a serious problem?. *Int J Health Sci (Qassim)* 2017;11(5):17-19.
4. Akouwuah PK, Nti AN, Ankamah-Lomotey S, Frimpong AA, Fummei J, Boadi P, et al. Digital Device Use, Computer Vision Syndrome, and SleepQuality among an African Undergraduate Population. *Adv. Pub. Health* 2021; 6611348: 1-7.
5. Mufti M, Sayeed SI, Jaan I, Nazir S. Does digital screen exposure cause dry eye? *Ind. J. Clin. Anat. Physiol* 2019;6(1):68-72.
6. Wang L, Wei X, Deng Y. Computer Vision Syndrome During SARS-CoV-2 Outbreak in University Students: A Comparison Between Online Courses and Classroom Lectures. *Front Public Health* 2021;9:696036.
7. Bahkir FA, Grandee SS. Impact of the COVID-19 lockdown on digital device-related ocular health. *Indian J Ophthalmol* 2020;68(11):2378-2383.
8. Bhattacharya S, Saleem SM, Singh A. Digital eye strain in the era of COVID-19 pandemic: An emerging public health threat. *Indian J Ophthalmol* 2020;68(8):1709-1710.
9. Faruqi S, Agarwal R, Kumar R. A study of the correlation between smartphone usage and dry eye in medical students at a tertiary care center. *Trop J Ophthalmol Otolaryngol* 2020;5(7):174-182.
10. McCarty CA, Bansal AK, Livingston PM, Stanislavsky Y L, Taylor H R The epidemiology of dry eye in Melbourne, Australia. *Ophthalmology* 1998;105:1114-9.
11. Lin PY, Tsai SY, Cheng CY, Hon Liu J, Chou P, Hsu WM Prevalence of dry eye among an elderly Chinese population in Taiwan: the Shihpai Eye Study. *Ophthalmology* 2003;110:1096-101.
12. Moss SE, Klein R, Klein BE. Prevalence of and risk factors for dry eye syndrome. *Arch Ophthalmol* 2000;118:1264-8.
13. Hu JW, Zhu XP, Pan SY, Yang H, Xiao XH. Prevalence and risk factors of dry eye disease in young and middle-aged office employees: a Xi'an Study. *Int J Ophthalmol* 2021;14(4):567-573.
14. Shanti Y, Shehada R, Bakkar MM, Qaddumi J. Prevalence and associated risk factors of dry eye disease in 16 northern West bank towns in Palestine: a cross-sectional study. *BMC Ophthalmol* 2020;20(1):26.
15. Courtin R, Pereira B, Naughton G, Chamoux A, Chiambaretta F, Lanhers C Prevalence of dry eye disease in visual display terminal workers: a systematic review and meta-analysis. *BMJ Open* 2016;6(1):e009675.
16. Sánchez-Valerio MDR, Mohamed-Noriega K, Zamora-Ginez I, Baez Duarte BG, Vallejo-Ruiz V. Dry Eye Disease Association with Computer Exposure Time Among Subjects with Computer Vision Syndrome. *Clin Ophthalmol* 2020 Dec 8;14:4311-4317.
17. Giannaccare G, Vaccaro S, Mancini A, Scoria V. Dry eye in the COVID-19 era: how the measures for controlling pandemic might harm ocular surface. *Graefes Arch Clin Exp Ophthalmol* 2020;258(11):2567-2568.